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BIOLOGICAL CONTROL OF WEEDS
LABORATORY-EUROPE

1981 ANNUAL REPORT

PROCUREMENT SECTION
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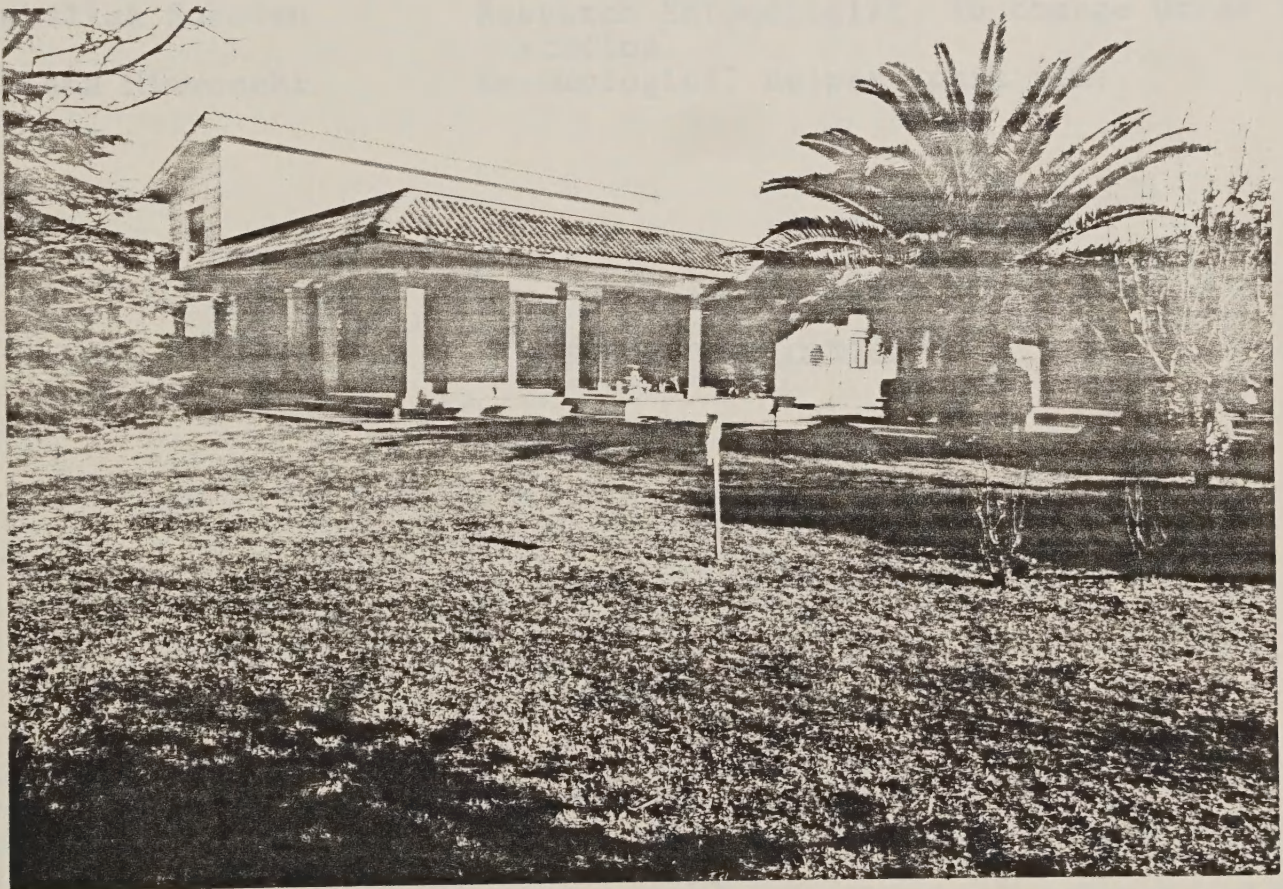
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BIOLOGICAL CONTROL OF WEEDS

LABORATORY-EUROPE

1981 ANNUAL REPORT



BIOLOGICAL CONTROL OF WEEDS LAB PERSONNEL

Neal R. Spencer ^{1/}	Research Entomologist, Location Leader
Paul H. Dunn	Research Entomologist
Antonio Rizza	Research Entomologist
Pasquale Pecora	Agricultural Research Assistant
Gaetano Campobasso	Agricultural Research Assistant
Donatella Magni	Administrative Assistant
Antonio Laregina	Gardner/Maintenance
Niklaus Hostettler	Technician, Univ. of Calif. Cooperative Agreement
Rouhollah Sobhian	Research Entomologist, In charge Greek Sub-station
Tiziana Mimmocchi	Entomological Helper, part time.

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1/ Returned to United States, Dec. 12, 1981.

INTRODUCTION

Paul H. Dunn

The year 1981 was an important one in the development of the Rome Laboratory, because of the move to new expanded quarters with modern research and office space and most important a large tract of ground that will serve as a fenced weed garden.

Since this move was made in May, it had a dampening effect on the research activity for that summer, nevertheless the accomplishments were respectable.

The Greek substation is in place and producing well under the direction of Dr. Sobhian. As it happens, the substantial natural populations of diffuse knapweed and yellow starthistle are all around the station at the Institute for Plant Protection at Thessaloniki.

At present, until the fauna of this local population of *Centaurea* spp. is exploited, Dr. Sobhian's work is practically at his door step.

It is also note worthy that Dr. Sobhian discovered a strain of *Urophora siruna-seva* (Diptera Trypetidae) in Greece that attacks US yellow starthistle. This is especially significant, because repeated introductions of this insect from Italy failed to colonize on US yellow starthistle.

On 12 December this year Neal Spencer, Location Leader left the Rome Laboratory for his new post at Stoneville, Mississippi, where he will work with Dr. Charles Quimby, on *Rumex* and other weeds, putting the quarantine there to good use after his four year European experience.

Paul H. Dunn
Research & Location Leader

June 25, 1982

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RELOCATION OF THE ROME LABORATORY

Neal R. Spencer

On 15 May 1981, the Rome Laboratory moved from its old address at Via Vincenzo Monti, 4 to a new location on the outskirts of Rome, Via Gastone Monaldi, 34, 00128 Rome, Italy. Telephone (direct dial from the US) 011(overseas) 39 (Italy) 6 (Rome) 648-0140 (Laboratory): 011-39-6-648-0140.

The previous site at Via Vincenzo Monti was in a residential area, not far from the center of Rome in the ground floor and basement apartment of a three story building, surrounded by a small garden. This location was selected by Lloyd Andres in 1959 and for about 20 years was adequate for the biological control of weeds program.

As interest in biological control of weeds grew, the staff and work load of the Rome laboratory also grew and by 1980, and even before, the original Vincenzo Monti site was no longer adequate, and we began casting about for new quarters.

Antonio Rizza located a villa, with surrounding farmland, just outside of Rome and I concurred that it would make an excellent laboratory location.

When Dr. Terry Kinney, Administrator ARS came to Rome on other business, we were able to show him the premises. On his return to Washington, Dr. Kinney consulted with Dr. Bertrand (Director USDA Science and Education), and they concurred that it would be advantageous to the program to lease the site.

The new laboratory is on 1 hectare of land (2.72 acres). About half the site is occupied by the main laboratory, out buildings, 2 greenhouses and a large park like lawn with mature ornamental and fruit trees, and the other half of the land was fenced and became our "weed garden". The fenced portion has been divided into 20 experimental plots, ranging in size from 6 x 12 m to 37 x 25 m, 12 of them being 12 x 12 m. The irrigation system is such that all of the plots can be watered as needed.

The main laboratory has about 3,200 sq ft (300 m²) of first quality office and work space.

The whole complex is in the south western edge of Rome, about 20 minutes from the International Airport at Fiumicino and about 11 miles (18 km) to the American Embassy in the center of Rome (1.5 to 3 hours round trip, depending on traffic).

With slight modifications (changing furniture) the building can house another two persons, sharing an office-laboratory. With addition of temporary partitions in one of the larger rooms, another two average size offices can be created, leaving the large library-meeting room free for those uses. With this room for additional personnel these quarters should be adequate, at least for the next decade.

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RUMEX CRISPUS//
N.R. SPENCER-N. HOSTETTLER

Seeds of *Rumex* spp. were collected from Italy, France and Poland in 1980 and held in cages at outside temperatures at the Rome Laboratory.

In the late spring of 1981 a variety of hymenoptera began to emerge from these seeds. These data are presented in Table I.

The numbers and variety of hymenoptera associated with the seeds was surprising. It is clear that many of the insects collected are not primary seed feeders, and this finding raised more questions than answers. On the other hand, it disclosed an ecosystem working in the seeds that we were unaware of. No doubt some of the wasps are primary seed feeders, thus useful candidate natural enemies are among the insects collected.

To refine the list and select only the seed feeding wasps (thus eliminating parasites of Aphids and of *Apion* weevils infesting *Rumex* seeds) we exposed *Rumex* seeds still on the plants to some of the emerging wasps. The data from these trials will be available in May-June 1982.

In addition to this work on the *Rumex* seeds Spencer collected diseased *Rumex* plants in western Europe, hoping to find more virulent strains of the organism causing a known disease of *Rumex crispus*. These specimens were given to Dr. G. Defago, ETH Zurich for isolation and identification. We feel that *Rumex* pathogens have the potential of being of useful biological control agent against this weed.

Table I. European collection sites and numbers of insect spp. emerged from the seeds of *Rumex* spp. host plants.

Insect	Locality	Plant	#insect found
HYMENOPTERA ^{1/}			
Eulophidae			
<i>Entedon</i> sp.nr. <i>costalis</i> Dalman	Italy, Lazio, Rome	<i>R. crispus</i>	2
<i>Tetrastichus</i> sp. nr. <i>epicharmus</i> (Walker)	France, Eure, Landepereuse	<i>R. obtusifolius</i>	100
"	Lazio, Maccarese, Rome	<i>R. crispus</i>	50
"	Italy, Abruzzi, Teramo	<i>R. crispus</i>	150
<i>T. sp.</i> nr. <i>conon</i> (Walker)	France, Yvelines, Versailles	<i>R. obtusifolius</i>	7
<i>T. sp.</i> <i>evonymellae</i> -group	Italy, Lazio, Rome	<i>R. crispus</i>	120
<i>T. sp.</i>	France, Eure, Landepereuse	<i>R. obtusifolius</i>	180
<i>T. sp.</i>	France, Seine-et-Marne	<i>R. obtusifolius</i>	15
<i>T. sp.</i>	France, Yvelines, Versailles	<i>R. obtusifolius</i>	4
<i>T. sp.</i>	Lazio, Maccarese, Rome	<i>R. crispus</i>	300
<i>T. sp.</i>	Abruzzi, Teramo	<i>R. crispus</i>	300
<i>Eulophida</i> sp.	France, Seine-et-Marne	<i>R. crispus</i>	50
Most specimens are unusually small, probably dwarfs due to adverse conditions during rearing.			
Pteromalidae			
<i>Systasis</i> <i>parvula</i> Thomson	France, Eure, Landepereuse	<i>R. obtusifolius</i>	1
"	Poland, Woj.Koszalinskie, Koszalin	<i>R. sp.prob.patientia</i>	24
"	Poland, Woj.Lesnczynskie, Leszno	<i>R. sp. "</i>	14
"	Poland, Woj.Siedleckie, Mordy	<i>R. sp. "</i>	3
Of the six species of <i>Systasis</i> known from Europe, the hosts of four species are not known. Two species are associated with gall forming Diptera. A species described from the intercepted <i>Cenchrus elemoides</i> seeds imported from Australia to India has been recorded as <i>phytophagous</i> (<i>Systasis cenchrivora</i> Farooqui and Menon, 1972. <i>Mushi</i> 46: 111-114. However, this observation needs to be carefully examined.			
<i>Chlorocytus</i> <i>laogore</i> (Walker)	France, Eure, Landepereuse	<i>R. obtusifolius</i>	2
"	France, Seine-et-Marne	<i>R. obtusifolius</i>	1
"	Italy, Lazio, Rome	<i>R. crispus</i>	3
"	Italy, Lazio, Rome	<i>R. crispus</i>	1
<i>C. laogore</i> has been reared as a parasite of the larva of <i>Apion</i> sp. (Coleoptera: Curculionidae) in the seeds of docks, <i>Rumex</i> sp., in the United Kingdom by Graham & Claridge (1965. <i>Trans. R. Ent. Soc. Lond.</i> 117: 296-298).			
Eurytomidae			
<i>Eurytoma</i> <i>flavimana</i> Boh.	France, Yvelines, Versailles	<i>R. obtusifolius</i>	4
<i>Eurytoma</i> sp.	France, Yvelines, Versailles	<i>R. obtusifolius</i>	2
Cynipidae			
<i>Phaenoglyphis</i> sp.	France, Eure, Landepereuse	<i>R. obtusifolius</i>	100
Hyperparasite of aphids through Aphidiidae and Aphelinidae. More material would be appreciated.			
Chalcoidea			
Unknown			
"	France, Eure, Landepereuse	<i>R. obtusifolius</i>	100
"	France, Yvelines, Versailles	<i>R. obtusifolius</i>	40
"	Italy, Lazio, Rome	<i>R. crispus</i>	15
"	Italy, Abruzzi, L'Aquila	<i>R. crispus</i>	4
"	Italy, Abruzzi, Teramo	<i>R. crispus</i>	2
"	Poland, Woj.Elblaskie, Nn.Duor	<i>R. sp.prob.patientia</i>	2
"	Poland, Woj.Lesnczynskie, Leszno	<i>R. sp.prob.patientia</i>	1
"	Poland, Woj.Siedleckie, Mordy	<i>R. sp.prob.patientia</i>	8

1/ Determinations made by the US National Museum and the British Museum.

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LEAFY SPURGE PROJECT

A. Rizza & P. Pecora

a) *Oncochila simplex* H.S.

The laboratory host specificity screening of this insect has been completed in 1980. The "petroleum plant" *Euphorbia lathyris* being considered as a source of energy, was found to be a suitable host. Therefore, a series of field tests were made during 1981 at San Rossore (Pisa), to ascertain the impact of *O. simplex* on *E. lathyris* under natural conditions. *Oncochila* is now in the USDA-ARS quarantine facility, Albany, California under additional tests with domestic endangered and economic *Euphorbia* species.

Test 1 (host preference)

On April 15, the experiment was set up as follows:

- No. plots: 10 of 1m² each
- Distance between plots: 1 m
- No. plants/plot: 8 *E. esula* and 8 *E. lathyris*
- Arrangements of the plants in the plot: 4 rows (2 with *esula* and 2 with *lathyris*) Fig. 1.
- Plant sources: *E. esula* directly transplanted from an *esula* plot in the farm.

E. lathyris grown in the laboratory greenhouse.

- *E. lathyris* varieties used: "Chico" in plots 1-2-3-6-7-; "Castro Valley" in plots 4-5-8-9-10.

Both *esula* and *lathyris* plants were young and healthy when transplanted in the plots. The plants in the plots were followed at regular 2 week intervals for 2 months and replaced in case of death. The experiment was conducted in a corner of a corn field and no other *E. esula* plants were present near or in the plot.

On June 17, 25 ♂ + 25 ♀ young adults of *Oncochila simplex* were released in the center of each plot. At the time, all the plants in the plots were in good conditions. Before the insect's release, the soil in the plots was covered with dead plants just to offer an adequate shelter to the insects. Every two weeks, a plant of *esula* and one of *lathyris* were randomly selected from each plot for dissection and the eggs, nymphs and adults on the plants were counted and damage recorded. The experiment ended when all the plants had been recovered (8 samplings in total). The results of the experiment are summarized in Table 1.

The test clearly indicates that *E. lathyris* is a suitable host of *O. simplex*. The insect can feed and reproduce on this plant even when the natural host *E. esula* is present. The damages caused on *E. lathyris* can be severe when the plants are young and in case of high *Oncochila* population.

Table 1. $\bar{x} \pm$ SD of eggs, nymphs and adults found on *E. lathyris* and *E. esula* during the periodical inspections. Means refer to 10 plant samplings of each species.

Sampling date	<i>Euphorbia lathyris</i>			<i>Euphorbia esula</i>		
	Eggs	Nymphs	Adults	Eggs	Nymphs	Adults
1/VII/81	20.40 ⁺ 22.50	0	.50 ⁺ .85	14.70 ⁺ 12.71	0	.60 ⁺ .70
15/VII	5.90 ⁺ 4.86	23.10 ⁺ 12.86	0	2.70 ⁺ 2.91	5.60 ⁺ 3.66	0
29/VII	11.80 ⁺ 10.16	8.00 ⁺ 7.82	1.50 ⁺ 1.90	7.40 ⁺ 3.31	3.10 ⁺ 3.18	.40 ⁺ .52
12/VIII	40.80 ⁺ 53.82	8.80 ⁺ 25.09	.90 ⁺ 1.66	11.70 ⁺ 27.04	0	1.10 ⁺ 1.52
26/VIII	13.50 ⁺ 15.69	10.50 ⁺ 7.85	1.00 ⁺ 1.89	7.60 ⁺ 7.06	3.70 ⁺ 4.55	2.40 ⁺ 3.66
9/IX	1.50 ⁺ 4.74	8.90 ⁺ 9.04	.40 ⁺ .96	8.40 ⁺ 8.38	4.50 ⁺ 4.50	3.00 ⁺ 4.74
23/IX	0	0	8.00 ⁺ 6.22	0	0	3.20 ⁺ 4.18
7/X	0	0	8.10 ⁺ 6.51	0	0	.20 ⁺ .63

Test 2 (suitability of *E. lathyris* to other natural enemies).

On April 15 a second test, simultaneous with the first one, was started in S. Rossore (Pisa). The main objectives of the experiment were:

- 1) to ascertain the suitability of *E. lathyris* for the existing natural enemies.
- 2) to verify any eventual host resistance in the *E. lathyris* varieties.
- 3) to see if *Oncochila* would move to *E. lathyris* in a natural situation.

In a 250 m² plot 60 young *E. lathyris* plants were transplanted in 6 rows of 10 plants each (3 rows with var. "Castro Valley" and 3 with var. "Chico"). The distance between plants in the row was approximately 1 meter. The distance between rows approximately 3 meters, and the distance between the two varieties was about 6 meters. Many *E. esula* plants were naturally growing in the plot. All the spontaneous plants in the plot, including *E. esula*, were left undisturbed. At San Rossore, *E. esula* is a natural host of many insects such as *Aphthona* spp., *Oberea erythrocephala*, *Neoplinthus tigratus*, *Hyles euphorbiae*, and the gall midges *Dasineura* spp.

Oncochila simplex is not naturally present in the area. On June 17, 150 (75 ♂ + 75 ♀) adults of *O. simplex* were released in the center of the plot. Starting from May 13 (one month after the planting), the *E. lathyris* plants were inspected every two weeks and any eventual insect or damage found on each plant was recorded.

Dasineura capitigena and *O. simplex* when were introduced into the area were the only insects found damaging *E. lathyris*. The damage caused to the apical tip by *Dasineura* prevents flowering of the plant, but this damage does not interfere with the plant's growth.

1/ The species has been placed in *Bayeria* but R.J. Gagne, Systematic Entomology Lab., ARS, USDA does not consider the name to apply to the *Dasineura* spp. on *Euphorbia* spp.

It is interesting to note that no *E. lathyris* tips were found to be attacked before July 1. Instead, gall midge damage on *E. esula* was found starting from May 13. This delayed attack on *E. lathyris* may be ascribed to the poor synchronization of the midge to the plant, because the midge needs a certain kind of apical tip and this is not present on *E. lathyris* until July.

Looking the number of *E. lathyris* plants damaged, of both varieties, it was found that the "Chico" variety is more susceptible to the *Dasineura capitigena* attack than the one from "Castro Valley". (60% infestation for var. "Chico" and 20% for var. "Castro Valley"). The plants of both varieties were the same age and at the same stage of growth therefore, exposed in the same way to the midge attack.

Oncochila, released in the plot later was also followed, and results of this test also confirmed the complete suitability of *E. lathyris* (both varieties equally) as a lacebug host plant, even when the dominant plant in the area is the natural host, *E. esula*. Even in a mixed population *Oncochila* can find the *E. lathyris* plants and reproduce on them. Four *E. lathyris* plants in the plot were found seriously damaged by *Hyles euphorbiae* and three killed probably by the fungus *Macrophomina phaseolina*, a serious pathogen of many crop species.

Test 3.

At Castelporziano, near Rome, a 500 m² garden of *E. lathyris* plants (varieties "Chico" and "Castro Valley"), was planted. *E. esula* and *E. cyparissias* are not members of the plant community in the area, and near the plot no other *Euphorbias* were present, not even annual species. The *E. lathyris* garden was prepared to better understand the plant's phenology and see if it would be attacked by local insects and/or pathogens. The only organism found to be a serious pest of *E. lathyris* plants in the garden was the pathogen *Macrophomina phaseolina*, which caused the death of about 30% of the plants.

We also used this *E. lathyris* garden to provide field data to support the host specificity studies on *Aphthona* that were being done at CIBC, Delemont. On June 22, twelve hundred adults (1200) of a mixed population of *Aphthona flava* and *A. cyparissias*, collected at San Rossore, were released in the plot. After one day, the *Aphthona* adults that had been released in the plot disappeared and no damage was seen on the *E. lathyris* plants after careful examinations.

b) *Dasineura capitigena* Bremi

To provide a start on host specificity testing and increase our knowledge on the bionomics of this species, a collection of 200 *E. esula* plants infested by *D. capitigena* galls was made in San Rossore (Pisa) on May 6, 1981. The plants were immediately potted (5/pot) and brought to the Laboratory.

Oviposition choice test

Before proceeding with a full test, we wanted to ascertain the host suitability of the various U.S. spurge taxa. In this preliminary test we used leafy spurge from Nebraska, Montana and Oregon (the only available in the lab) plus the important cultivated species, *Euphorbia pulcherrima*, *Euphorbia lathyris*, and *E. marginata*. *Euphorbia esula* from San Rossore was used as control for the whole series. *Euphorbia antisiphilitica*, *E. tirucalli*, and *E. millii*, other important *Euphorbia* species, were not included because these plants do not offer the appropriate oviposition niche to the midges.

The infested plants, brought from San Rossore, were carefully examined every day until May 20, when the first *Dasineura* adults were noticed flying around them. On May 22, the experiment was set up in the lab garden using potted plants setting on the ground. Three replicates per plant species or taxon were used. To provide a high midge population, for each test plant we used one pot of *E. esula* infested by *Dasineura* galls. All the plants were randomly arranged in seven rows of six pots each. The plants were left undisturbed for 4 weeks, approximately the time necessary for a new generation. The number of infested and non-infested tips were recorded for each test plant.

The experiment showed the host suitability of all the US leafy spurge taxa included in the test. However, the plants from Nebraska were found to be less suitable for the midge. Among the cultivated plants tested, only *E. lathyris* was found to be attacked by *D. capitigena*.

Larval survival test

The same plant species were used as for the preceding test. Fifteen tips per each plant species were infested with 20 eggs of *D. capitigena* collected in *E. esula* galls. To prevent any interference by *D. capitigena* adults existing in the garden, the test plants were caged in transparent plastic cylinders 20 cm x 60 cm. The top of each cylinder was covered with nylon organdy to give sufficient aeration to the plants. The potted plants were maintained in the garden in a shaded area to prevent high humidity and temperature in the cylinder.

The experiment started on May 25 and ended three weeks later, on June 15. The galls formed were dissected and the number of larvae and/or pupae found in the galls were recorded. The results of the experiment are summarized in Table 4.

The results obtained in this test were similar to the previous test. Galls were found on all the U.S. weedy spurges and, even if in lower percentage, on *E. lathyris*. Also in this experiment the spurge from Nebraska was found to be less suitable to the midge attack compared with the other US spurges tested. It seems, therefore, that the Nebraska spurge is different from the taxa found in Montana and Oregon.

Table 4. Larval survival test.

Test Plants	No. of galls obtained	Larvae		Pupae	
		mean	SD	mean	SD
<i>Euphorbia esula</i> (control)	14	4.64 \pm 4.40		9.64 \pm 5.30	
Leafy spurge (Nebraska)	3	6.00 \pm 2.00		4.66 \pm 2.08	
" " (Montana)	11	3.27 \pm 2.10		8.27 \pm 3.59	
" " (Oregon)	12	4.08 \pm 2.11		6.16 \pm 3.56	
<i>Euphorbia lathyris</i> ("Chico")	5	3.80 \pm 1.48		0.40 \pm 0.54	
<i>E. marginata</i>	0				
<i>E. pulcherrima</i>	0				

Bionomics

Dasineura capitigena, a multivoltine species, probably overwinters as a larva or pupa in the soil or in the galls dropped on the soil. At San Rossore (Pisa), adults emerge at the beginning of April and continue to be active into October, because fresh galls were observed on *E. esula* from the end of April to the end of October.

According to our observations, the midge needs about a month to complete the life cycle. Therefore, probably 5 or more midge generations occur on *E. esula* in San Rossore. In middle May, adults of *D. capitigena* were observed, early in the morning, flying around the host plants in a shaded area of the lab garden.

The color of freshly laid eggs is light red, turning darker with the age. The eggs are laid on the external leaves of the apical tips. The newly hatched larvae move to the internal part of the apical tip and feed on the youngest leaves. The feeding causes the external leaves to gather together. These gathered leaves have a protective role, making a "growing tip gall". The infested apical tips do not develop normally and are sometimes completely destroyed by the insects. The number of larvae found in a single gall ranged between 19 and 32 (sample of 25 galls). In captivity, the average fecundity was 50.5 eggs/female and the average adult longevity (mean of 6 pairs) was 4 days. *D. capitigena* larvae were heavily parasitized by *Tetrastichus* sp.

c) *Dasineura capsulae* Kieff.

In San Rossore this midge is quite common on *Euphorbia cyparissias* and rare on *E. esula*. Like *D. capitigena* 200 plants of *E. cyparissias*, infested of *D. capsulae*, were brought to the Lab in Rome. However, the galls were so heavily parasitized that few adult *D. capitigena* emerged. The impression is that it is not easy to handle this midge, because it is so heavily parasitized and because it needs a perfect synchrony with the host plant: the plant must be in bloom for the midge attack. In a testing program it will be difficult to have all the test plants at the right age. Anyhow, we will try again in 1982 hoping to find new locations with less parasitism.

d) *Oberea erythrocephala* Schrank

The difficulty to find and collect large numbers of *Oberea* is well known. This year we were lucky to find in the San Rossore preserve relatively large areas of *E. esula* and *E. cyparissias* with a good *Oberea* population. We were able, therefore, to collect about 600 adults and send them to the USDA Lab., Albany, Ca. where they were used for direct field releases.

San Rossore is one of the very few areas in Italy left undisturbed, and where *E. esula*, *E. cyparissias* and *Oberea erythrocephala* are in equilibrium in the ecosystem. To break the equilibrium there with frequent and massive collections of *Oberea* is not advantageous and could possibly destroy the population of *Oberea*, thus the area as a collection site. Anyhow, the 1982 collection will be made there with the hope of finding additional collection sites to lessen the pressure on San Rossore.

Work Plans for 1982

Oncochila simplex H-S

The screening of this insect has been completed this year with the field tests made to ascertain the impact of the tingid on *E. lathyris* under field conditions. *Oncochila* is now under quarantine facility at Albany, California.

No work planned for 1982 in Rome.

Oberea erythrocephala Schrank:

Large collections for direct field release in the U.S. will be made in Italy and, if necessary, elsewhere in Europe. Priority will be given to this collection.

Midges:

Emphasis will be put on continuing the study of *Dasineura capitigena* and *Dasineura capsulae*. Since plants from US were not made available, in 1982 only the plants that we were able to find in the various botanical garden in Europe will be tested.

Chamaesphecia spp.:

According to the Dunn-Radcliffe-Smith report, there are at least 5 morphologically separable leafy spurge taxa in the US: *Euphorbia esula* s.st. *E. esula* s.l. (*E. androsaemifolia*); *E. pseudovirgata*; *E. virgata* var. *uralensis*; *E. virgata* var. *orientalis*. The *Chamaesphecia* used in the tests at Albany was an Austrian strain collected on *E. esula*. The US spurge offered to the insect at Albany came from Oregon, according to Paul Dunn. Dr. Radcliffe-Smith classified the material from Oregon as *E. virgata* var. *orientalis*. Because there are several locations of *E. esula* s.st. in the

US, it would be worthwhile to try to colonize Austrian *Chamaesphecia* in those areas. For the other US spurge taxa we hope to find usable strains of *Chamaesphecia* by looking on the right plants at the right time. The failure to find *Chamaesphecia* on *Euphorbia* species other than *E. esula* may be ascribed to the wrong period of search. Survey trips should be done in the fall, when it is possible to see dead plants and find mature larvae.

In October 1981, two hundred (200) *E. esula* and fifty (50) *E. cyparissias* roots infested by larvae of *Chamaesphecia* spp. were collected in Austria. The infested roots are available in the Rome Lab.

The species on *E. esula* should be *C. tenthrediniformis* Den. & Schiff. and the ones on *E. cyparissias*, *C. empiformis* Esp. It is our intention to try both species on the various US leafy spurge. Both species can probably be colonized in North America if they are released on the correct spurge taxon.

Simyra dentinosa F.:

The insect was first found by Paul Dunn in Afghanistan and later in Turkey on *E. virgata* var. *orientalis*. We found the insect in Greece on *E. seguierana*. In May 1981, Dr. Sobhian shipped a number of larvae of the Greek strain to Rome. They arrived stressed and just in the middle of moving the laboratory to a new location, so the results of the feeding test done with them may not be valid. The almost mature larvae did not accept the US spurge offered and all died before pupation. At the moment no other spurge were available to feed them. In 1982 to keep the logistics simple, it is planned to send to Dr. Sobhian representatives of each US taxa, so he can try the various spurges starting with first instar larvae. If any of the US spurge will be found host suitable to *Simyra* full tests will be done in Rome in 1983.

Neoplinthus tigratus Rossi:

Little time will be spent. We believe, however, that this insect has good potential as a biocontrol agent of leafy spurge. The damage caused by larvae to large *E. esula* roots is severe. This root damage is more severe than that caused by either *Oberea* or *Chamaesphecia*. The insect is also compatible with *Oberea* as we have found mature larvae of both insects in the same root. We have not found yet the adult's food source (s). Two Curculionid specialists, Dr. Enzo Colonnelli, University of Rome, and Prof. Osella, University of Verona, do not exclude the possibility that the adults use dead plant material as food. To check this hypothesis, a researcher at the Rome University, will examine the origin of the food in the intestine of field collected adults. At the moment we have in the lab garden almost 200 roots infested by *Neoplinthus* larvae.

Dicranocephalus spp.:

The two specimens brought from Russia by Paul Dunn were given to him by Dr. Kovalev. One was *Dicranocephalus agilis* Scop. and the other *D. medius* Mul. & Ray. Paul Dunn was unable to collect any *Dicranocephalus* species during his Russian trip.

In the Fauna of Italy, Vol. IX, of the National Academy of Entomology, are listed: *Dicranocephalus agilis agilis* Scop (Sp. Eurosibirica-Mediterranea), common in Italy; *D. agilis moralesi* Wagn. (Sp. Maghrebina), found in Sicily and Malta; *D. albipes* F. (Sp. Euromediterranea), common in Italy; *D. marginicollis* Put. (Sp. Mediterranea), found in Piemonte, Abruzzo and Sardegna; *D. medius* M.R. (Sp. Euromediterranea), common in Italy; *D. pruinosis* Horv. (Sp. Alpina), found in Friuli-Venezia Giulia; *D. setulosa* Ferr. (Sp. Mediterranea), common in Italy.

No host records are given for any of these species.

Dr. Carlo Leonardi of the Museo Civico di Storia Naturale, Milano, examined the *Dicranocephalus* specimens in the Museum at Milano and found no host records. Dr. Leonardi, however, quoting Stichel, give for *D. agilis* the following hosts: *Euphorbia*, *Calendula*, *Calluna*, *Erica*, *Berberis*, *Juniperus* and *Pinus*. For *D. medius* Stichel give *Euphorbia* species and *Salvia pratensis*.

We are waiting also information from other Museums in Italy. We hope, during the coming season, to find a good population of *D. medius* (apparently the more specific) to bring to the lab and establish a colony.

Eurytoma spp.:

During the 1979 trip made in the Balkans by Andres and Rizza, seeds of *E. seguierana* attacked by *Eurytoma* sp. were found in Romania. Since probably we will be travelling in eastern Europe in 1982, we hope to find again *Eurytoma* and get a colony started in the lab.

Aphids:

We will collect and preserve material wherever found and get it identified.

Trips:

We will be travelling in Italy and probably in Eastern Europe in June-July for the large *Oberea* collections. A trip is scheduled in the Balkans in September-October for *Chamaesphecia*, *Eurytoma* and *Oberea* infestation

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MUSK THISTLE PROJECT //

A. Rizza and G. Campobasso

Cheilosia grossa Fallen.

In order to ascertain the host specificity of *C. grossa*, a larval survival test was made in Rome during the year 1981 with two strains of the fly, one collected at Castel Porziano, Rome (sea level) and Sila, Calabria (1,300 m elevation).

A big portion of the *C. grossa* field biology has also been completed. The only gap in our knowledge concerns the adult mating behaviour and fecundity. We hope to fill this gap the coming spring. Dissections of other thistles were made at Castel Porziano and Sila to see if we could find *C. grossa* larvae. Our laboratory tests and field observations (dissection of other thistles), confirmed the literature records, ie., that *Cheilosia grossa*'s host range is restricted to the *Carduus* genus and that other plants (crop and thistles) in the tribe Cardueae resulted not suitable hosts.

The damage caused by *C. grossa* larvae in the roots and stems is severe, often causing the death of the plant. We feel that *Cheilosia* is a good potential biocontrol agent and can be safely introduced into the U.S. if the remaining tests on endangered native *Cirsium* species, programmed in Rome for 1982, give negative results.

The complete study on *Cheilosia* will be published soon.

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CENTAUREA DIFFUSA //

G. Campobasso

Pterolonche inspersa (Lepidoptera: Pterolonchidae) is a small, whitish-gray moth whose larvae feed on the roots of *Centaurea* spp.

Distribution

In correspondence with Dr. L. Gozmany at the Museum Allattara, Budapest, *P. inspersa* has been collected from Spain, France, Soviet Union, Hungary, Greece, Turkey (Anatolia), Bulgaria, Romania and Italy. Precise locations for these collections were not given and the reference to Italy probably refers to a very old record if collected from *Centaurea diffusa* or collections from *Centaurea paniculata* or *C. maculosa* both of which are recorded from northern Italy.

Taxonomy

At the time these insects were sent for identification, the Rome Laboratory had an arrangement with the British Museum for identification. The specimens were sent there originally but the identifier suggested confirmation of his determination by a specialist in the group, Dr. H. J. Hannemann, (Zoologisches Museum Humboldt, Universität Berlin). Dr. Hannemann, after examination of the specimens including preparations of the male genitalia, was sure they were *Pterolonche inspersa*.

Host plants

Examination of the Review of Applied Entomology (1918-1981), and the Zoological Record (1920-1970) provided no host plant records for this insect, but it has been collected, according to unpublished data of Dr. Helmut Zwolfer, (Univ. of Bayreuth, Bayreuth, W. Germany) from *Centaurea diffusa*, *C. paniculata* and *C. maculosa* in northern Greece, in surveys made between 1961 and 1971.

When Campobasso was collecting *Pterolonche* in northern Greece, about 50 plants each of *Onopordum* spp., *Cirsium* spp., *Sonchus* and *Carduus* spp. growing in the area were dissected and examined for the presence of *P. inspersa* larvae. No larvae were found in any of these nearby related plants, thus the preliminary information suggests that the insects are fairly specific (stenophagous) to the genus *Centaurea*.

Biology and Life History

The information on the life history and biology presented here is based partly on laboratory findings. The field information was gotten during a survey and two collecting trips - to Greece in June and July 1979, 1980, 1981, and the laboratory information comes from observations made in Rome during the rest of the year in 1980 and 1981.

Oviposition

The eggs of *P. inspersa* have been seen only in caged trials, and in these trials they were laid indiscriminately in the cage on the walls on plants, etc. In nature it is supposed that they are more or less randomly placed on the *Centaurea diffusa* plant during the first decade of August.

Larvae

The first instar larvae, after eclosion, feed down the root of the plant, some mining the woody portion and others feeding on the epidermis. The feeding location of the larva probably depends on where the egg was laid on the plant, i.e. larvae from eggs put near the center of the plant probably mine the woody portion of the root while those eggs that were placed on the peripheral portion of the plant most likely produce larvae that feed on the outside layer of the root.

Based on the observations made in Rome, the larva probably feed until about half grown (3rd instar) and overwinter in that stage. When the weather warms in the spring the larvae start to feed again, probably pupating in early July and emerging during the last half of July to mate, lay eggs, etc. making it a univoltine species. The roots of the knapweeds are small by nature, so many are seriously damaged by the one or two larvae feeding in each plant that make galleries 3-5 cm long and 2-2.5 cm wide.

In addition, some observations were made on the length of the pupal, adult and egg stages of the insect under outside conditions. These findings are presented in Table 1.

Very likely when the larvae start to feed, they spin a characteristic silken tube lining the gallery they have made or covering the area they have fed on. The larvae stay in the tube, increasing its size as they grow. Eventually the tube is spun with an opening near soil surface, and the larva overwinters in the tube and pupates in the tube just below the soil surface, thus the tube offers both protection during the pupal stage and easy exit route from the soil for the emerging adult.

Preliminary tests

Two different tests were made to determine the host specificity of *Pterolonche* and acceptance of American biotypes of diffuse knapweed. The first of these was an oviposition choice test and the second was a first instar larval survival test.

Oviposition choice test

In order to determine the oviposition preference, if any, 7⁰⁰ and 7⁰⁰ adult *P. inspersa* were confined for 10 days in each of four cages with the following potted plants: *Centaurea diffusa* (Greece) control; *Centaurea diffusa* (USA); *Centaurea solstitialis*; *Centaurea cyanus*; *Zinnia elegans*.

The test cages were 90 x 90 x 90 cm and 90 x 90 x 160 cm and two of each size were used (2 replicates). The cages were kept in the garden and were large enough to permit the adults to fly inside and select plants for oviposition. The results of this trial are presented in Tables II and III.

First instar larval survival test

To find the acceptability of the following plants as hosts, 5 potted plants (replicates) of each of the following species were each infested with 5 newly hatched first instar larvae (25 larvae/each test plant species).

Centaurea diffusa european (control); *Centaurea diffusa* (USA) control; *Cynara scolymus*; *Carthamus tinctorius*; *Helianthus annuus*; *Helianthus tuberosus*; *Aster chinensis*; *Cichorium intybus*; *Achillea millefolium*; *Tanacetum vulgare*; *Centaurea solstitialis*; and *Centaurea cyanus*.

During the experiment all the plants were kept out of doors, under natural conditions and the test lasted from August 17 until September 30, when the experiment was stopped. All plants were then dissected under a stereo microscope and the surviving larvae were counted, collected and stored in ethyl alcohol. The results are presented in Table IV.

Discussion

Larvae survived only on the *C. diffusa* control. Two larvae were recorded from each of the 5 replicates in the European *C. diffusa* control and two larvae were recovered from all but one of the 5 replicates in the US. *C. diffusa* control for a total of 19 larvae from the two controls.

Thus, 33% of the larvae used to infest *C. diffusa* controls were recovered compared to no larval recovery from any of the other plants in the test.

Table I. Biological data of *Pterolonche inspersa* Stgr. July-Sept.81

		Laboratory reared adults	
		(\bar{x}	SD)
Pupal stage (20 insects)	(days)	14.7	2.4
♀ longevity (10 ♀♀)	(days)	15.8	2.6
♂ longevity (10 ♂♂)	(days)	10.7	1.4
Preoviposition period	(days)	2.6	0.8
Oviposition period	(days)	7.4	2.2
Fecundity (# eggs/♀)		142.2	59.2
Hatching period	(days)	12	4.7
% eggs hatched ^{1/}			36%

1/ Eggs in biological study reached blackhead stage, but failed to hatch. Data for % hatch were taken from 1249 eggs collected in field cages.

Table II. Oviposition choice test, small cage (90x90x90 cm)

Test plant	Rep I	No. eggs Rep II	Total
<i>Centaurea diffusa</i> (Greece - control)	208	195	403
<i>Centaurea diffusa</i> (U.S.A.)	171	199	370
<i>Centaurea solstitialis</i>	12	0	12
<i>Centaurea cyanus</i>	1	0	1
<i>Zinnia elegans</i>	0	0	0
Total	392	394	746

Note: From a total of 766 eggs collected, 342 hatched= 44%

Table III. Oviposition choice test, large cage (90x90x160 cm)

Test plants	Rep I	No. eggs Rep. II	Total
<i>Centaurea diffusa</i> (Greece-control)	134	46	180
<i>Centaurea diffusa</i> (U.S.A.)	129	109	238
<i>Centaurea solstitialis</i>	0	0	0
<i>Centaurea cyanus</i>	0	0	0
<i>Zinnia elegans</i>	0	0	0
Total	263	155	418

Note: from a total of 483 eggs collected 111 or 22% hatched

Table IV. First instar larval survival trial (Plants dissected 30 days after infestation).

Replicate No.	1	2	3	4	5	Total larvae alive
Plants tested	No. larvae alive at dissection ^{1/}					
<i>Centaurea diffusa</i> (Greece)	2	2	2	2	2	10
<i>C. diffusa</i> (U.S.A.)	2	2	2	2	1	9
<i>Cynara scolymus</i>	0	0	0	0	0	0
<i>Carthamus tinctorius</i>	0	0	0	0	0	0
<i>Helianthus annuus</i>	0	0	0	0	0	0
<i>Helianthus tuberosus</i>	0	0	0	0	0	0
<i>Aster chinensis</i>	0	0	0	0	0	0
<i>Chicorium intybus</i>	0	0	0	0	0	0
<i>Achillea millefolium</i>	0	0	0	0	0	0
<i>Tanacetum vulgare</i>	0	0	0	0	0	0
<i>Centaurea solstitialis</i>	0	0	0	0	0	0
<i>Centaurea cyanus</i>	0	0	0	0	0	0

^{1/} Five 1st instar larvae placed on each plant replicate

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YELLOW STARThISTLE //

Paul H. Dunn

Introduction

Most of the previous exploration for insects attacking yellow starthistle has centered around the mature plants. In picking up this project, I wanted to change the emphasis and study the fauna (and flora) associated with the rosettes of yellow starthistle because I felt this stage of the plant had not received enough attention in the past, because of the difficulty of finding and identifying the rosettes.

The work in this first year was in two phases. The first was to study the biota associated with rosettes near Rome and the second phase was to locate "mother plants" while they were in flower or a visible stage, thus easy to find, and mark them so I could return in the spring and make periodic examinations of the rosettes.

Phase 1

For the first phase of the work, I was fortunate, to find a family of 20 small rosettes in April, ranging from 8-16 cm in diameter (mean 11.8 cm). These rosettes were observed more or less at 10 day intervals until August 7. Sometime after August 7 the field was plowed and the experiment thus terminated.

During the observation period 10 observations (April 21, 28, May 7, 18, 27, June 2, 12, July 2, 23, Aug. 7) were made on the following features. Rosette diameter, insects seen, evidence of disease, occurrence of a multiple center (insect damage), number of buds and flowers and plant mortality

Field Observations

1. Rust disease on plants. On the first observation (21 April) eighteen of the 20 plants had some symptom of rust disease - ranging from a heavy to a light infestation. Two of the plants were without visible symptoms.

As the season progressed, all of the plants showed rusted leaves at one time or another. The leaves most severely attacked were the outer rosette leaves, nearest the ground. This continued through the June 2 observation. On the June 12 observation only one plant (No. 7) was noticed to have obvious disease symptoms, ie., pustules on the leaves. It rained before the next observation (July 2) where 12 of the plants were recorded as having rust pustules on the leaves. By the 23rd of July this was reduced to 4 plants showing disease symptoms, the diseased leaves having dessicated. On the last observation, August 7, only two plants (No. 1 and 11) showed signs of disease. These plants never bolted and the rosettes were dying probably from a combination

of disease and insect damage. The rosette sizes were 16 and 10 cm diameter in April, but in August were reduced to 7 and 5 cm diameter.

2. Rosette diameter. The mean diameter for the 20 plants at the beginning of the observation was 11.8 cm (range 8 to 16 cm). The mean rosette diameter of the nine plants that bolted was 26.2 cm (with a range of 18 to 32 cm). One plant grew to normal size and bolted, but the flower heads were completely distorted by some disease or damage that has been observed pretty much through out the range of yellow starthistle in Italy, but whose causal organism or factor is unknown.

Some plants never bolted. As the peripheral leaves of these rosettes dried, the living central part kept getting smaller and normally finished about half the size of rosette at first observation. These rosettes resembled miniature spinach plants more than yellow starthistle.

3. Insect damage. The principal insect damage seen was the production of multiple growing points in the center of the rosette. There was also the occasional hole in a leaf or a leaf that had been partially eaten, but these were regarded as being of little importance. Also on June 12 it was noticed that something was feeding on and hollowing the buds of one plant (No. 8). This activity continued to be observed through July 23, and always on the same plant. The causal organism was never seen and little importance is attached to the damage, because only one plant was involved. It may have been a chance attack by a polyphagous lepidoptera.

The damage to the plants crowns, resulting in abnormal growth of the center of the plant is due to an *Apion* sp. weevil.

There was no damage to any of the plants at the April 28 observation, but by May 7, three plants with multiple growing points were seen, increasing to 9 on May 18 and 12 by May 27. In order to determine the cause of the damage, a plant not under regular observation was taken to the laboratory and dissected. The plant had eight growing points (instead of only one found on a normal undamaged plant). In the tissue of the crown of the plant were 5 adult *Apion* weevils, 1 pupa and two mature larvae, leaving little doubt as to what was causing the damage.

On May 27, an adult *Apion* was collected from plant No. 1. It moved out of the rosette as it was being examined. On June 23 four more adult *Apion* were collected from plants 11, 12, 13 and 19. These insects were identified as *Apion* (*Ceratapion*) *alliariae* Herbst, with some reservations, and that "eventual positive identifications should be sought by European experts". Dr. Whitehead also mentioned that *Centaurea solstitialis* was the principal host for which they have records. The insects will be sent to get another determination.

Another insect that may be of interest is a flea beetle that was associated with the plants. While no damage directly associated with the flea beetle was seen, their presence on the deformed rosettes made them suspect. Two specimens were sent for determination and were

returned identified as *Longitarsus* sp. nr. *ganglbauri*. This insect also deserves a closer look by an European specialist on flea beetles.

In addition to these two insects assorted aphids, thrips, spittle bugs and mites (probably predaceous) were seen, but did not effect enough (if any) damage to be of interest.

In addition to the insect natural enemies of the plant the rust mentioned earlier inflicted severe damage to some of the plants, especially those weakened by insect damage. This organism was identified as *Puccinia centaurea* DC (classified according to Gauman). More material will be necessary in order to find the teliospores for host specificity studies. At present, we can consider this rust as a possible candidate natural enemy, pending the discovery of negative information.

Phase II

The second phase of the work (locating infestations of yellow starthistle in southern Italy) was only half successful. There was no problem locating and marking the plants, but it appears that all the plants marked as yellow starthistle in Sicily were *Centaurea solstitialis* var. *schouwii*.

All the material collected this summer was taken to the Istituto di Botanica at Florence and examined by a *Centaurea* specialist, Dr. Arrigone. The material collected in Puglia was *Centaurea solstitialis* var. *solstitialis*. The material collected in Sicily was all *Centaurea solstitialis* var. *schouwii*.

As it turns out, in reality variety *schouwii* is a different species with a different phenology, chromosome count and different seeds. I noticed the yellow starthistle in Sicily had green rosettes in August (the Rome plants had dried rosettes). *C. solstitialis solstitialis* has ($2n=16$) chromosome count while *C. solstitialis schouwii* has ($2n=18$) chromosome count.

A further difference was noticed as I was dissecting the heads to see what insects were present. *C. solstitialis* var. *solstitialis* had the well known peripheral ring of dark seeds without pappus and pappus bearing seeds at the center of the flower head. This was not the case with var. *schouwii*, which had only one kind of pappus bearing seed. It was interesting to notice that the seeds of *schouwii* that were probably most resistant when located in the center of the inflorescence. They were probably no different than the peripheral seeds, but were buried deep in the center of the flower head and were hard to extract. Being located in this manner one is lead to think that they cannot germinate, or find the ground until the phyllaries and receptacle are weathered away, thus probably being resistant for one or more years, as well as lending themselves to passive distribution.

In any case, some interesting insects were found in Sicily, but since it has been discovered that this is probably a much different plant than our Western US species, future work will be directed towards the variety *solstitialis* which is found primarily west of the Appenines from Rome north to Livorno, and in Puglia near Castel del Monte.

The interesting insects that emerge from the southern collections will be sent for identification, and will be considered as candidates, but not priority candidates for introduction, if others are found on the variety *solstitialis*.

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CENTAUREA SOLSTITIALIS //

R. / Sobhian and T. / Mimmocchi^{1/}

Introduction

This report deals with investigations carried out by the substation of Thessaloniki mainly in connection with biological control of *Centaurea solstitialis* (yellow star thistle - YST). The substation was established Feb. 1981, in the Plant Protection Institute of Thessaloniki.

The substation was operated by one investigator during 1981 except for 3 months (June-August) when Ms. Tiziana Mimmocchi was sent from the Rome Laboratory to provide technical assistance for the project.

Remarks on *Centaurea solstitialis*

YST is not considered as weed in Greece. The plant is scattered more or less along roads, fields and neglected agricultural land. It is absent in range lands where the soil has not been plowed.

Also, the literature is not in agreement on whether yellow star-thistle is an annual or biennial. Flora Europea (Vol IV) described the plant as a biennial while Flore de la France describes it as an annual, and Robbins et al in Selected Weeds of the United States, Agric. Handbook No. 366, 1970, described as either an annual or biennial.

Since my work plan called for flowering plants of the US yellow star-thistle varieties, it was very important to know if the seeds sown in February would flower in 1981 or 1982.

We thought the plants might need vernalization for flowering so we started 3 experiments in order to increase the possibility of having YST flowers the first year as well as to test the life cycle of the plant.

Part 1. Seeds grown in "Jiffy sets" which are an individualized peat moss starting medium for single or small number of seeds. These seeds were kept at room temperature then transferred to pots and later transferred to the garden beds.

Part 2. Seeds started in "Jiffy sets" then after germination the seedlings were treated with cold (vernization), by alternating them between the refrigerator (4°C) for 16 hours/day and room temperature 8 hours/day. This treatment was continued for one week. After the cold treatment they were managed as the plants in trial 1.

Part 3. Seeds were planted as in No. 1 but 5.0 ml of 0.1% gibberellic acid was added to each "Jiffy set", and the seedlings were treated as number 1.

^{1/} Work conducted at Rome Laboratory Substation, Thessaloniki, Greece.

All the seeds in all 3 trials were planted on February 18, transferred into pots on March 4 and moved out of doors to the garden on April 15. At the beginning the treated plants (trials 2 and 3) were smaller than those in trial 1. The plants in trial 1 had a mean height of 4 cm while plants in trials 2 and 3 had a height of 2.2 cm. This difference disappeared later in the summer and all the plants flowered around June 20-25.

Two varieties of California YST seeds were used in this experiment (Placer Co. and Woodland). No great difference was noted between the two varieties, however, the rosettes of the Woodland variety had larger leaves and was generally more robust than the other one.

About 300 plants were grown and all the plants both US and Greek plants from Athens, Lamia and Thermi flowered in June.

General Program

The local YST is very abundant around Thermi, the location of the Plant Protection Institute. In order to be sure that any insects found also attacked the California YST, 4 US varieties were grown. These were from Placer County, California (CA, P), Woodland, California (CA, W), Yakima County, Washington (W1), and Klickitat County, Washington (W5). These plants were interplanted with the local Thermi YST and safflower seeds (*Carthamus tinctorius*) to provide plant material for our various tests.

In addition to this planting at the Institute garden, 20 seedlings of each of 3 of the US varieties (W1, W5 and CA, P) were interplanted in a naturally occurring infestation of YST about 3 km from the laboratory. This locality became known as the Yellow star garden.

All the YST plants were observed throughout the summer, and promising natural enemies were collected. However, obvious general feeders like snails, grasshoppers and aphids were ignored.

At the end of the growing season, before going to seed, all the US yellow star plants were collected. Some of these were saved because they contained *Urophora siruna-seva* larvae, but most were destroyed.

In addition to observing and collecting from YST, a continuous search was kept up for pathogens from *Euphorbia* spp., *Convolvulus arvensis*, *Centaurea diffusa*, *Chondrilla juncea* and *Rumex* spp.

Urophora siruna-seva (Dipt. Trypetidae) (HG.)

This fly has been reared from flower heads collected in various parts of southern Italy by L. Andres in 1960 and by Zwolfer in 1966 (Tech. Bull. CIBC 1969). The literature survey and screening test made by Zwolfer showed that this fly is a potential biocontrol agent for YST and he recommended its introduction to California. The fly was introduced from Italy to California but it failed to establish there. In a list of insects collected on *C. solstitialis*, which according to literature appear specific to the genus *Centaurea* prepared by E. Piattella, N. Spencer, and A. Rizza (Ann. Report 1980), *U. siruna-seva* was discarded, because it failed to establish in California. It was not known why *U. siruna-seva* did not establish in California, but we felt

that there must be a *U. siruna-seva* biotype that would accept the California plants as hosts. Therefore, it was decided to collect representatives of as many biotypes of *U. siruna-seva* as possible and expose them to US-YST, hoping that the right one would be among them. Nine different samples of overwintered flower heads were collected in March, two each from Yugoslavia, Hungary, Bulgaria and one was sent from Rumania as well as the Greek sites of Athens and Lamia.

When flies started to emerge (second half of May) the US-YST seedlings were still small and it was not possible to keep the nine different ecotypes of *siruna-seva* flies separately and feed them until the US seedling reached the bud stage. Also, it was not certain if they would flower this year. On April 28, part of infested seed heads were put in refrigerator at 8°C to delay emergence of flies. By June 5, *siruna-seva* flies were all emerged in the refrigerator, so all the ecotypes were put among YST plants in the Institute garden, hoping they would survive until the US plants will be in bud.

By May 29 the first buds were seen on the US plants and by June 19 the first flowers were seen on these plants. The first flowers on the local (Thermi) Greek plants were recorded on June 5 and the first adult *U. siruna-seva* fly was observed sitting on a local YST on 14 June.

On June 11 one pair of *U. siruna-seva* were observed copulating on a bud of a US YST plant (CA, P). The copulation ended after ca. 30 minutes (the maximum copulation time recorded was 56 minutes). Shortly after copulation the female started searching for a suitable bud, very young to medium size buds being acceptable for oviposition. After about 5 minutes she found a bud that was suitable to her and probed it three times during the next 5 minutes then she departed.

This bud was collected and dissected and one egg was found in it.

If proper buds are offered to the females, they accept them readily and multiple oviposition can occur in any one bud.

These observations were all made in the garden of the Institute at about midday. The temperature was ca. 32°C and the RH about 55%.

During the four day period June 13-16, 26 buds in which females had probed with their ovipositor were labelled. From June 18-25 all the labelled buds, starting with the older ones were dissected. Nothing was found in 24 of the buds but in one bud, dissected on June 18, two small larvae were found and in a second bud dissected on June 25, one small dead larva and a little frass was found. In another bud, (dissected 24 June), some frass but no insects were found.

The first fly and the other galls were collected from the US plants in the Institute garden. Only one male, in addition to the first six insects emerged August 26. These flies were sent to the IIPi group at Beltsville and their identity was confirmed as being *U. siruna-seva*.

Later, (August 2-25), because of the finding of *U. siruna-seva* in the US plants a collection of all the available ripe flowerheads of the California YST in the YST garden at Thermi was made. A number of the heads of each variety of YST were dissected to give us an idea of the % of infestation and the possible number of flies available. The results of these dissections are presented in Table 1.

Table I. Degree of infestation of three US-YST varieties by *U. siruna-seva* in YST garden in Thermi.

Plant Variety	No. of Dissected Heads	No. of Galls	% Infestation
W1	102	46	45.0
W5	167	9	0.05
CA, P	445	23	0.05

There is a striking difference in the rate of infestation between the 3 US plant types in the YST garden. It is not clear why W1 appears to be the most heavily attacked.

Heads of YST in the Institute garden were also dissected and the percentage infestation of 4 US varieties were recorded. The results of these dissections are shown in Table II.

Table II. *U. siruna-seva* infestation rate on US-YST in Institute's garden.

Plant Variety	W1	W5	CA,W	CA,P
No. heads dissected	100	150	150	200
No. of galls	5	1	12	26
% infestation	0.05	0.007	0.08	0.13

BANGASTERNUS ORIENTALIS (Capiomont) (Coleop. Curculionidae)

This species was collected by Buckingham 1.5 miles E. Atalandi, Greece, 31 May 1971 on shoots of *C. solstitialis* (Ann. Report 1980, Rome). Here in Thermi it was first seen 12 May 1981 copulating on YST. Last adults were observed on YST 14 July 1981. The insect was common, but only found on the larger and stronger plants. Specimens sent for identification were identified by Whitehead, Beltsville, Md. and the identity was confirmed by R. Thompson in British Museum and Dr. Janczyk, Natural History Museum, Vienna.

Biology and preliminary host specificity tests.

Ten adults were put on safflower bouquets and another 10 on yellow starthistle bouquets on 22 May. Those on YST started feeding the first day while those on safflower did not feed until 7 days later (May 29).

A field test was also conducted in which 50 adults of *Bangasternus*

were collected and released in the YST garden on the grounds of the Institute where both US and Greek YST were interplanted with safflower. No preference was observed between the US and Greek YST, but the insects were never found on safflower even though extensive attention was given to searching for them, checking the plants at least once daily.

Oviposition started on June 10 when the first eggs were found on YST. In the laboratory garden they laid as many as 10 eggs/bud and as many as 80 eggs per YST plant. Not a single egg could be found on safflower during this period. In egg counts in the field, away from the Institute garden, oviposition on YST was also high and as many as 8 eggs/bud were found on the plants.

A host selection trial was made in the laboratory, confining 7 adult *Bangasternus* (5♀♀ and 2♂♂) on safflower bouquets with a control of 2♀♀ and 1♂ on YST bouquets. The test started on June 22. On the first day the insects in the control laid 15 eggs on YST while the test insects on safflower were all dead on June 26 without laying a single egg.

Most of the eggs are laid on small leaves near the buds or directly on the flower buds. After placing the egg the female covers it with a black substance, probably feces or regurgitated material.

On hatching the larva penetrates directly into the plant tissue. If the egg is laid on a bud the larva penetrates directly into the bud. If it is laid on a leaf, the larva enters the leaf mines toward the stem then turns upward and mines into the bud from below. (See Fig. 1).

A single larva can consume most of the contents of a flower head. In fact, no more than 1 larva was found in any flower head even though there were a number of eggs laid on the bud or the nearby leaf, from which they would have entered the bud.

The egg mortality is very high. Many eggs were obviously parasitized (even though no parasites were collected) and is also suspected that some of the eggs are killed by predaceous bugs before hatching because frequently flower heads were found without a larva and with no evidence of an egg parasite.

To have an idea of the mortality rate of immature *Bangasternus*, we dissected 100 YST heads that had at least one egg on them, and produced the following results.

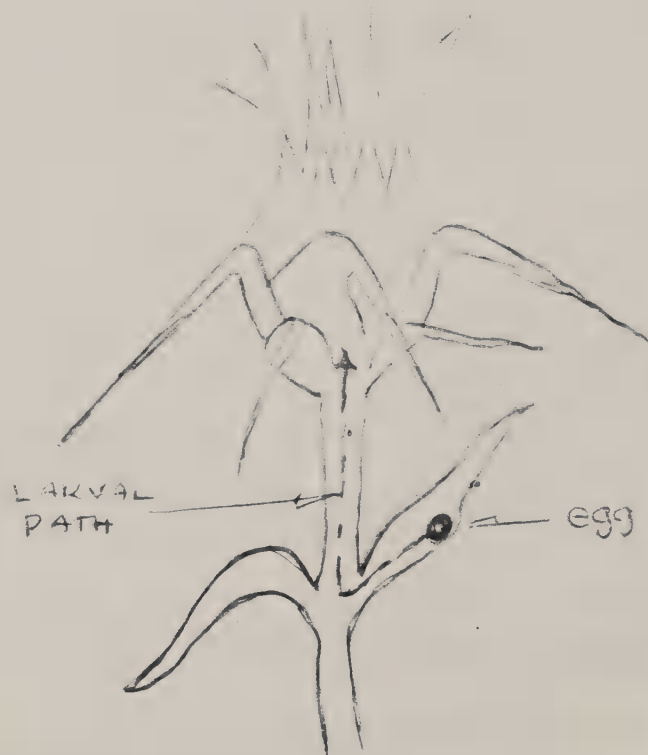
No. eggs seen	147
No. eggs not hatched	24(no parasite holes, no larval frass)
No. eggs parasitized	41(emergence holes seen)
No. larvae alive	9
No. larvae dead	4(probably parasitized)

Thus, only 6% of the eggs laid became healthy larvae, therefore adults, provided there are no subsequent mortality factors to further reduce the survival rate.

A second collection of infested heads from Policastro produced results depicting an even lower percentage of eggs becoming adults. From 120 infested heads collected only 4 larvae of *Bangasternus* were found. One of these seemed healthy but the other three were parasitized.

Adult emergence of *Bangasternus* began late in July. The first record we have is 27 July and this one came from some dissected plant heads we

Yellow star head with path of *Bangasternus* larva.



- Fig. 1

kept in the laboratory for rearing. From another small sample collected at the end of July and kept in the laboratory another two adults emerged 14 August.

Also on 14 August, we collected 2000 heads of a California variety of yellow starthistle and these were kept in a large screen cage out of doors. Seventeen adults emerged from this collection on the following dates Aug. 30, 2; Sept. 3, 3; Sept. 4, 11; Sept. 8, 1; and no more.

Since these beetles were the stage that would overwinter they were put into a glass terrarium with some dried plant material so their behavior could be observed, and were kept in the laboratory until 20 October, then moved outside and observed until 10 November when the laboratory was closed for the winter. On February 2, 1982 they were still found to be in diapause.

During this observation period the insects moved very little, but did not hide themselves until some time after 10 November. Before hiding they remained immobile, often in a copulating position, but without actually joining. At times there would be 300⁺ attempting to get into position with a single female.

These newly emerged adults were offered potted YST seedlings until 10 November, and even though there was warm weather they never fed. On February 3, 1982, when the laboratory was re-opened the beetles had hidden in the debris of old plants and in holes in the cardboard cover of the terrarium (14) and 3 were hidden in an old YST flower head. None were found in the soil covering the bottom of the terrarium.

There is a report in the literature by M.E. Ter Minasyan that *B. orientalis* feeds on safflower in Armenian USSR. Knowing that, we gave careful attention to safflower, about 300 safflower heads from plants growing intermixed with YST were dissected, looking for *Bangasternus* eggs, larvae or adults. None were found. Another sample of 100 heads was collected and kept caged through the emergence period. This from 400 safflower heads from plants grown intermixed with YST, there was no evidence that safflower is an acceptable host plant to the Greek ecotype of *Bangasternus orientalis*. On the other hand, *B. planifrons* infests safflower in Greece. A more detailed study of the relationship between *Bangasternus orientalis* and safflower is planned for next year.

1. *Lachneus* sp.

This beetle was found in Doirani, Greece, 24 June mating on Yellow starthistle plants. While *Lachneus* was common in this site, *Bangasternus* was absent. Several of these weevils were collected and taken back to the laboratory for initial host specificity and biology studies.

For the host specificity tests, on 27 June, 5 adults were caged in cloth screen bags on plants of Greek YST, California YST and safflower (all with young buds) were growing in the laboratory garden.

On April 4 the plants in the cages were dissected with the following results:

Greek YST	3 buds infested 2 with larvae, 1 with an egg
US YST	1 bud heavily damaged (no larvae found) 1 with an egg
Safflower	buds and leaves heavily damaged, no larvae, no eggs.

To effect oviposition the beetle makes a shallow gallery or round hole in the plant bud with her mouthparts then lays one or two eggs in the hole and covers them with a black substance. Sometimes there are holes with no eggs, but they are not covered with the black material.

Several laboratory feeding and oviposition trials using bouquets of Greek and US YST and safflower were made. Safflower was always attacked. The insects made holes in the safflower buds, similar to those in YST, but they never oviposited in the safflower holes. In another trial, two medium sized buds and two pair of beetles were used in each treatment and each treatment lasted 24 hours and was repeated 3 times. The results of this trial were:

Greek YST	9 empty holes	11 eggs
US YST	16 empty holes	4 eggs

The eggs hatched within 3 days at laboratory temperature (20-29°C).

While no eggs were deposited on safflower in any of the trials, some larvae were transferred to safflower buds and seemed to feed normally for the period of observation. During the dissection of the buds of yellow starthistle, it was noticed that before the eggs hatch the content of the bud near the egg become an amorphous jelly like substance. It is postulated that when the female oviposits she introduces an enzyme into the bud that softens the YST tissue thus providing a soft food for the young larva.

If this is true and if the enzyme is specific to YST tissue it could be used as an herbicide against YST, thus open a new door in weed control.

2. *Apion penetrans*

This weevil collected in southern France and Spain by Zwolfer (CIBC Report No. 1) was recorded as an important natural enemy of YST. In Greece, it is the most important natural enemy attacking the rosette of YST. In Zwolfer's host specificity trials the adults fed on potted safflower and artichoke plants more heavily than on YST plants. Since the insect is an important natural enemy a survey was made to see if a race specific to YST or at least stenophagous on *Centaurea* could be found in Greece.

From Thermi, Greece eggs and young larvae were found in the collar and roots of YST plants on 14 April and in collections made on 26 May only pupae were found.

Plants collected in Asprovalta 27 April and 15 May and kept in moist sand in the laboratory produced adults on May 21. In some of these earlier collections, larvae were feeding 15 to 20 cm up into the stems of the plants. Plants collected in the field on 28 May contained mainly frass and a few pupae. About 20 samples of YST rosettes were collected from different localities and almost all were infested with *Apion*. As many as 23 larvae were dissected from the root of large bolting plants. Twenty six adults emerged in the laboratory and were used for adult feeding tests. Safflower and YST bouquets were tested separately.

They fed on safflower as readily as they fed on YST. Also in a feeding test with field collected *Apion penetrans* they started feeding on safflower the first day.

3. *Cassida* sp. (Coleoptera: Chrysomelidae)

This insect was found on US YST in the Institute garden. Adults feed well on safflower. Not common, no further investigation planned.

4. *Larinus curtus* (Coleoptera: Curculionidae)

This species was found both on US and Greek YST. Since this beetle was tested by Zwolfer (CIBC Report No. 6, 1968) and adults fed both on artichoke and safflower, no further investigations were made.

5. *Isocalus* sp. (Hymenoptera:

This insect was reported from southern France and Spain by Zwolfer, and he indicated it should be studied because of its high degree of specificity.

Dissection of US YST (variety WI) on 26 August was the first time we found this wasp. Subsequent dissections of US YST varieties (W5, CA, P) also disclosed *Isocalus* galls. The galls are usually made in single achenes and are apparent in mature flowers, before drying. However the rate of infestation was low.

6. *Phytomyza* sp. (Diptera:

This leaf miner was first seen on 29 October on small US YST seedlings grown in boxes out of doors in Greece. Leaves of all varieties of YST were infested. The first pupa was seen on 1 November and they continued to pupate until 9 November. The pupae were taken to Vienna where observation continued and adults emerged until 15 November. Adults were given to Dr. G. Weizbauer, University of Vienna for identification. He determined the specimens as *Phytomyza* sp. perhaps unidentified. They have been sent to Germany in hopes of having a specific name.

7. *Eriophyes centaurea* (Ocarina: Eriophyidae)

8. *Cyphocleonus morbillosus* (Coleoptera: Curculionidae)

Both 7 and 8 are recorded as potential candidates of YST, but thus far they have not been found in northern Greece.

9. Nematodes

Several diseased, heavily stressed plants were collected 4 May at Thermi. Roots were swollen and abnormal showing nematode damage. Field collected plants put into pots died. An attempt to infest US YST plants and safflower plants failed. In the Institute garden some US YST plants were dug up 18 August and found to be heavily attacked by nematodes. This nematode was identified as *Meloidogyne incognita* by the Institute nematologist. This is a polyphagous species. Specimens were sent to Watson (Canada) for confirmation of the identification. No reply yet.

10. Fungus Diseases

Twenty-six samples of fungus diseased YST plants were collected. Twenty three were mailed to ETH Zurich and three to Dr. Watson in Canada. An attempt to infest US-CA, P plants in the institute succeeded, but no heavy damage obtained. The diseased sample infested with *Puccinia centaurea* was collected April 15 and put among US plants in the institute. These plants were covered with a glass cylinder 20 cm diameter x 20 cm high for one week. The glass cylinder was shaded to prevent direct sunshine and overheating. On 30 April a few rosettes were infested with the rust. A spore-suspension was applied to WI, W5, Ca, P, CA, W and safflower (all potted plants) and the plants were covered with transparent plastic bags in the glass house.

Other factors affecting *C. solstitialis* in Greece.

a. Animals

Besides large number of polyphagous insects and snails feeding on *C. solstitialis* in this area, sheep, goats and cows feed on it wherever they get access to it. In the area around Thermi and near Kavala, anywhere those animals were grazing in presence of YST, the plant was eaten as one of the most favourite food plants. The situation is such, that the Greek shepherds would probably complain about controlling or destroying the plant. In July, in a pasture near Thermi, flowering YST plants could only be found close to a big thistle or shrub, where the animals did not have access to them, otherwise plants were pruned again and again by animals thus preventing them from flowering. Animals do not feed on YST in the United States according to Mr. F. R. Lawson.

b. Ants

During a mass collection of ripe YST flower heads in mid-August, ants were observed to selectively carry away YST seeds. A few hours later we wanted to collect some of these ants for identification but they were no longer carrying YST seeds, because there were no seeds left on the ground. After we shook a few plants which dropped some seeds, the ants started to work immediately. Specimens of the ants were left in Rome for identification.

c. Effect of summer rainfall

The following observations were made:

On August 14 it rained and on August 17, the first germinated YST seeds were observed in the Institute's garden. Fifty seedlings were labeled the same day. August 24, all the labeled seedlings were dead, except three, which were inadvertently watered along with an apple tree.

August 25, it rained again. YST seeds were sown in garden, this date and by August 28, fifteen seedlings came up from these seeds. All of them died (dessicated) by September 15.

August 31, 100 seedlings were labeled in a field near the Institute. On September 14, 65 of them were dead, 17 alive and 18 were missing. On September 19, 9 more were dead and 8 alive, showing a 92% mortality seeds that germinated as the result of an August rain.

On August 29, thousands of YST seedlings were observed along a road in Thermi. By September 4, some seedlings were found alive only on more moist places. Also on September 4, four other locations were visited searching for YST seedlings.

Results:

- Location I: one hour search = 6 seedlings found
- Location II: 40 minutes search = no seedlings found
- Location III: seedlings common along a plowed field, where enough moisture was present.
- Location IV: 30 minutes search = no seedlings found

On October 1st, all 4 of these locations were visited again, and no seedlings could be found. These observations show that rainfall in July, August, and September destroy a large part of YST seeds. This matter will be investigated in more details in 1982, because 50 year precipitation records show that it rains at least once a month, even in summer and autumn in northern Greece. (Table 3).

Table 3. Monthly rainfall June - September

Precipitation Records for years	Locality	June	July	Aug.	Sept
		precipitation in mm			
1927 - 1977	Thermi, near	31.5	26.16	16.95	31.90
	Salonika				
	Ag. Mamas near	36.40	25.80	15.10	39.63
1931 - 1940	Kriopigi				
	Mories near	73.7	34.3	29.4	23.7
	Doirani				

Unknown disease

An unknown factor kills large number of YST plants, starting around the end of May becoming more common in June. Some of the US YST plants in the Institute garden died within a few days after exhibiting symptoms; some plants exhibit symptoms then recover.

Attempts to find insect, mite or nematode damage, and bacterial or fungal causal agents were all negative. Plant pathologists in the Plant Protection Institute Salonika, postulated that the causal agent might be due to a virus. Aster yellows virus is known to attack *Centaurea* spp., but its host range is not restricted to genus *Centaurea* (Zwölfer, personal communication).

Soil analysis

Soil samples were requested by the Albany laboratory (Don Maddox), therefore three locations were selected for analysis in connection with YST growth in northern Greece.

1. Doirani, where the largest YST population, so far known to us, occurs.
2. Thermi, where YST plants are scattered.
3. Kiriopigi (Cassandra, Halkidiki), where everything seems to be favourable for YST to grow but no plants have been found.

Deep and surface composite samples were taken from each locality. Each composite sample consisted of 20 single samples taken in a zig-zag pattern. Surface samples were from 0-5 cm and deep samples from 5-25 cm. The samples were analyzed by the Soil Science Inst. Thessaloniki and the results of the analysis is shown in Table 4.

Table 4. Chemical and physical characteristics of soil samples from three localities in Greece

Locality	Type of sample	Textural Class	% free CaCO ₃	PH Saturated Paste	% Organic Matter	Available P, P.P.M. (Oslem)	Available K ₂ O mg/100gr (Girks)	ECX 10 ³ Satur Extrac
Thermi	S	SC	11.6	7.65	1.53	15.0	23.7	0.84
"	d	SCL	14.9	7.70	-	3.2	17.9	0.67
Kiriopigi	S	SC	7.7	7.40	2.71	15.8	8.9	0.58
"	d	SC	9.7	7.40	1.64	5.7	4.8	0.78
Doirani	S	SL	1.5	7.50	0.85	15.4	9.2	0.45
"	d	SL	0	5.85	0.18	6.7	3.1	0.36

SCL = Sandy, clay loam; SC = Sandy, clay; SL = Sandy, loam.
S = surface sample; d = deep sample.

Services for other weed project.

1. *Euphorbia*

a) 9 rust samples were collected, prepared and mailed to Zurich for their studies.

b) *Simyra dentinosa* (Lepidoptera: Noctuidae). Rome Laboratory requested eggs or larvae of *Simyra dentinosa* from an area near Seres. Since it was not known when and where the eggs are laid nor how they look it was not possible to find eggs until May 1, when newly hatched larvae were present. An extensive survey of the plants on which young larvae were feeding showed that eggs are not laid on or around flowers, as it was expected, but were laid in regular dense rows on the back-side of single leaves about 20 cm. down from the tops of plants. Only the egg chorion remained but they showed where the eggs were placed on the plants. About 2000 larvae were collected at this site and the younger ones were sent to Rome for testing. The remaining larvae were caged and reared to adults at Thessaloniki. According to a communication with Mr. Neal Spencer, director of the Rome Laboratory, the larvae did not feed on US *Euphorbia esula* and they were no longer interested in getting pupae or adults of this moth. In tests in Greece, two other *Euphorbia* species (*E. myrsinites* and *E. helioscopion*) were accepted as food, even in presence of the host plant *E. seguieriana*.

2. *Centaurea diffusa*

a) Three rust samples were collected prepared and mailed (2 samples to ETH Zurich, one sample to Mr. Watson, Canada).

b) Root samples. Beside the necessary services provided to Dunn and Campobasso during their collecting trip to Greece, 3 root samples infested with *Pterolonche* were collected and mailed to Rome.

3. *Convolvulus arvensis*

a) One rust sample and one *Erisyphe* sample were collected, prepared and mailed to ETH Zurich.

b) Three samples of *Eriophyes convolvuli* (Acar.) and three seed samples of *Convolvulus arvensis* were collected and mailed to Albany, Ca. requested by Rosenthal.

4. Miscellaneous fungus diseased samples.

A sample of *Rumex*, 7 samples of *Chondrilla juncea*, 3 of *Cirsium arvense* and one of *Tribulus terrestris*, were collected, prepared and mailed to ETH Zurich for tests.

5. *Cyperus rotundus*

About 20 root samples were examined searching for *Heterodera mothi*.

reported from Iraq by Mothi et al., but the nematode was not found.

Visitor

Necessary assistance was provided to Mr. F.R. Lawson, who worked here for one month on YST ecology.

Other insects collected on US YST

1. *Chaetorelia* sp. (Dipt.), attacks safflower.
2. *Acanthiophilus helianthi* (Dipt.), attacks safflower.
3. *Bruchidius* sp. (Col.), was not found on safflower. According to a personal communication with Prof. Zwolfer this is the first report and the beetle might be a new species.
4. *Lasioderma* sp. (Col.), attacks safflower.
5. *Lixus* spp. (Col.), 3 species found but are probably not host specific to be candidates.
6. Flea beetle, feeds on safflower
7. *Larinus minutus*, only one specimen found on plants.
8. *Anthocoridae*, reared from heads, polyphagous.
9. Lepidoptera larvae, feeding in flower heads, kept for rearing.
10. *Larinus curtus*, not found on safflower.

Parasites

Hosts

- | | |
|-------------------------------|--------------------------------|
| 1. <i>Exeristes roborator</i> | <i>Bangasternus orientalis</i> |
| 2. <i>Eurytoma robusta</i> | <i>Bangasternus orientalis</i> |
| 3. <i>Harbocytus</i> sp. | <i>Lachnaeus</i> sp. |
| 4. <i>Bracon</i> sp. | <i>Bangasternus orientalis</i> |
| 5. <i>Eurytoma tibialis</i> | <i>Urophora siruna-seva</i> |

Work Plan for 1982

1. *U. siruna-seva*

We plan to grow US YST, intermixed with artichoke and safflower in a field, where local YST and *U. siruna-seva* is common in order to see if the fly will attack the two economically important plants.

2. *Bangasternus orientalis*

The host specificity of this beetle is going to be tested in the Rome Lab. Material (adult beetles) will be mailed to Rome for their tests. Further investigations on the biology of the insect will be carried out here.

3. *Eriophyes centaurea* and *Cyphocleonus morbillosus*

According to literature these are potential candidates for BC of YST but we could not find them in the surveyed area. More search will be carried out in other areas of Greece, hoping to find them.

4. More attention will be paid to *Isocalus* sp., which is probably specific to YST and attacks US YST.

5. YST rosette mortality factors will be studied in detail, comparing Italian, Greek, and US YST grown along with safflower in a 4 x 4 latin square.

6. Effect of summer rainfall on YST seedlings will be studied in more detail.

7. Other studies or collections requested by the Rome Laboratory will be undertaken as time and possibility permit.

Literature

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Insects shipments from Rome Lab.

Weed-Insect	Location	No. Stage Date	Shipping Method	Receiving Location
Leafy spurge <i>Oncochila simplex</i>	Piacenza, I	50♂ 50♀ A* Jan. 81	Airfreight	Albany, Ca.
" "	Piacenza, I	47♂ 47♀ A 20 nymphs Sept. 81	Airfreight	Albany, Ca.
Cypress spurge <i>Oberea erythrocephala</i>	Pisa, I	302 A June 81	Airfreight	Albany, Ca.
" "	Pisa, I	202 A July 81	Airfreight	Albany, Ca.
Canada thistle <i>Urophora cardui</i>	Mulhouse, F	1,200 galls	APO Airmail	Albany, Ca.
Curly dock <i>Pyropteron chrysidiforme</i>	Teramo, I	440 eggs Oct. 80	APO Airmail	Stoneville, Ms.
" "	L'Aquila, I	200 eggs July 81	APO Airmail	Stoneville, Ms.
Field bindweed <i>Galeruca rufa</i>	Bari, I	107 A 2 L** July 81	Airfreight	Albany, Ca.
" "	Rome, I	5 P*** 262 A Aug. 81	Airfreight	Albany, Ca.
" "	Rome, I	301 A Aug. 81	Airfreight	Albany, Ca.
Diffuse knapweed <i>Spenoptera jugoslavica</i>	Greece	80 A June 81	Airfreight	Albany, Ca.

* Adults
** Larvae
*** Pupae

Publications

None

Travel 1981

Mar. 31 - Apr. 3	Rizza and Pecora to Pisa and Piacenza to set up a field experiment with <i>Oncochila</i> on <i>Euphorbia esula</i> and <i>E. lathyris</i>
Apr. 9 -13	Campobasso to Sila to collect <i>Cheilosia</i>
Apr. 13 - 14	Rizza and Pecora to Pisa for field experiment.
Apr. 13 - 16	Dunn to Pisa
May 5 - 7	Pecora to Pisa to survey the field experiment.
June 16 - 20	Rizza and Pecora to Pisa to survey the field experiment.
June 17 - 25	Dunn and Campobasso to Greece to collect <i>Pterolonche</i> and <i>Sphenoptera jugoslavica</i> .
June 24 - July 1	Spencer to Germany, Netherlands and Switzerland to pick up the new Laboratory official car, and to make extensive collections of plant pathogens on <i>Rumex</i> sp.
June 30 July 4	Rizza and Pecora to Pisa to survey the field experiment.
July 14 - 16	Spencer, Dunn, Rizza and Pecora to Pisa and Venice to show Mr. Thoft (State Representative for Montana), and Mr. Miller (Cattlemen's Assoc. of North Dakota) how field experiments are carried out.
July 21 - 24	Campobasso to Sila to collect <i>Cheilosia</i>
July 28 - 29	Pecora to Pisa to survey the field experiment.
July 27 Aug. 1	Dunn to Bari to collect insects on <i>C. solstitialis</i> .
Aug. 11 - 12	Rizza to Pisa to survey the field experiment.
Aug. 11 - 20	Dunn to Sicily to conduct a field survey on <i>Centaurea</i> .
Aug. 25 - 26	Pecora to Pisa to survey the field experiment.

Sept. 3 - 4	Dunn to Agropoli, YST research
Sept. 8 - 9	Pecora and Laregina to Pisa to survey the field experiment.
Sept. 20 - 24	Dunn to Switzerland with Dr. Shrum (USDA Plant Disease Res. Lab., Frederick, MD) to visit Dr. Defago's Lab.
Oct. 6 - 10	Rizza and Pecora to Pisa to survey the field experiment, and to Verona to confer with Prof. Ruffo, Director of the Verona Museum.
Oct. 27 Nov. 4	Rizza and Pecora to Austria to field collect <i>Chamaesphecia</i> and <i>Urophora cardui</i> for shipment to Albany, Ca.
Nov. 11 - 14	Pecora and Laregina to Pisa to survey the field experiment.
Dec. 12	Spencer returned to Stoneville, Ms.

Visitors

March 24	Dr. Daniel L. Noble, Research Ecologist, U.S. Forest Service, Rocky Mountain Forest and Range Exp. Sta. Forestry Lab., S.D. & M & T Campus, Rapid City, SD57701
March 29	Dr. Terry Kinney, Administrator, USDA-AR, Washington, DC
July 13	Dr. Bob Thoft, State Representative for Montana, and Mrs. Thoft, and Mr. Kyle Miller, Cattlemen's Association of North Dakota, Turner, ND Mr. Michael D. Sternberger, Agricultural Counselor, American Embassy, Athens, Greece.
Sept. 2	Dr. Robert Shrum, USDA-ARS Plant Disease Res. Lab., Frederick, MD
Sept. 21	Dr. Carlos Avalos, Consejero Agrícola da Argentina, Buenos Aires, Argentina.
Nov. 9	Dr. Herbert Rothbart, Director, USDA-ARS, Eastern Regional Research Center, Philadelphia, PA.
Nov. 11	- Mr. Thomas A. Hammer, Deputy under Secretary of Agric. for International Affairs and Commodity Programs and Mrs. Hammer. - Dr. Joan Wallace, Administrator, OICD/USDA and Rev. Maurice Dawkins (Dr. Wallace's husband).

- Mr. Larry Steckline, Mid-America Agricultural Network, and Mrs. Steckline.
- Mr. D.H. Thomas, Agricultural Cooperative Development International, Washington, DC and Mrs. Thomas.
- Mrs. Kay Patterson, Publications Consultant, FAO (formerly Editor Foreign Agriculture, FAS/USDA).
- Mr. James Lake, Heron, Haggart, Ford, Burchette & Ruckert Law Firm, Washington, DC and Mrs. Lake.
- Mrs. Marlene Guroff, representing the Attache for UN Food and Agricultural Affairs.
- Mr. Edmund L. Nichols, Agricultural Counselor, American Embassy, Rome, Italy.
- Ms. Mollie Iler, Agricultural Attache, American Embassy, Rome, Italy.

Nov. 23 -26

Dr. Anthony Wapshere, and Dr. John Scott, C.S.I.R.O. Biological Control Unit, Montpellier, France

Partial list of recipients of this report.

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